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Forest Service

Forestry Research West

February 1993

A report for land managers on recent developments in forestry research at the four western Experiment Stations of the Forest Service, U.S. Department of Agriculture.

Forestry Research West

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Cover

An airplane scatters grass, forb, and browse seed over a strip of pinyon-juniper forest where the trees have been uprooted to produce more forage for big game on a Utah game range. Read about this unique partnership between the Intermountain Research Station and the Utah Division of Wildlife Resources aimed at improving big game winter range, beginning on page 12.

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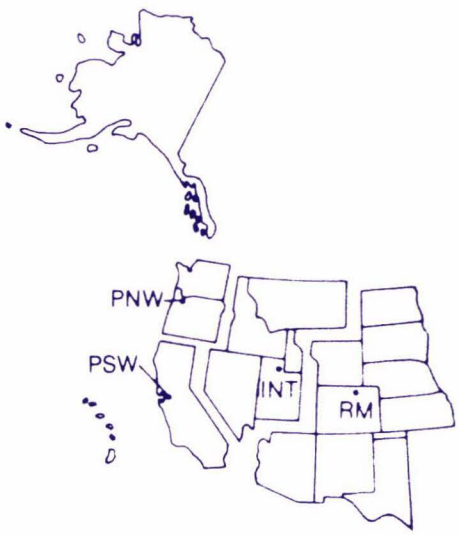

Protecting the northern goshawk in the Southwest

by Rick Fletcher
Rocky Mountain Station

With a long, rudder-like tail and short, rounded wings, the secretive and speedy hunter streaks through the forest canopy in search of prey. This is the northern goshawk (*Accipiter gentilis atricapillus*). The largest of the forest hawks found in North America, it is often labeled as the most agile, aggressive and fiercest hunter in the forest.

In the Southwestern U.S., censuses have shown that the goshawk population appears to be declining. Forest management practices—including timber harvesting and fire suppression—are among the suspected causes. Because of these concerns, the goshawk is listed as a sensitive species by the Forest Service.

Being a raptor, the goshawk is also at the top of the food chain, preying on a host of small-to-medium mammals and birds. As a result, it has been designated as an "indicator" of the health of its environment by the Forest Service's Southwestern Region (Arizona and New Mexico), and has become a focus of scientific studies.

An adult goshawk.

In 1990, the Southwestern Region established a committee to "develop a scientifically-credible management strategy to conserve the goshawk". Richard Reynolds, research biologist with the Forest Service's Rocky Mountain Station, is lead scientist for the committee which includes people from a range of disciplines from the National Forest System, Forest Service Research, and academia. "The committee has developed management recommendations that have been accepted by the Forest Service as the framework for a national approach to protect the goshawk," says Reynolds.

What makes these recommendations unique is their landscape ecology approach. "The basic concept," he explains, "is to manage entire ecosystems for a full range of age-classes presented in a pattern that will provide habitat not only for goshawks, but for their primary prey and the overall forest environment as well, including other animal and plant species." This approach is in keeping with a recent change in Forest Service policy at the national level which places more emphasis on total ecosystem management.

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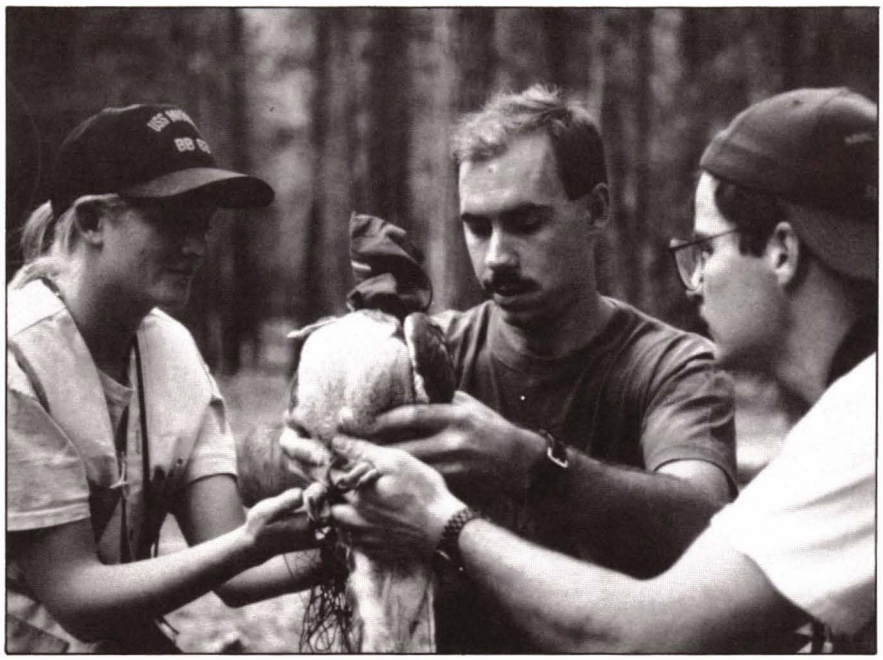


Scientists band and measure an adult bird after trapping it in its nest area. Birds are hooded to minimize stress caused by handling.

Broadcast surveys

The research involved a contract between the Kaibab National Forest (Arizona) and the Rocky Mountain Station. Under the agreement, surveys for nesting goshawks were carried out on the North Kaibab Plateau during the summer of 1991 and 1992. "This forested area is the only one in the Southwest that was not railroad logged at the turn of the century," says Reynolds. "The Plateau is the only area left today with many mature and old trees and remains a goshawk 'heaven' of sorts."

Surveyors established a series of transects and broadcast stations. From each station a tape player was used to play the goshawks' alarm and food-begging calls. Various observations were then recorded before moving on to the next station. Five people spent 676 hours surveying a total area of 184 square kilometers. From a total of 2,883 stations, 61 active goshawk nests were located and studied.

The committee considered the following key elements in its management recommendations: 1) home range, 2) prey, and 3) present forest conditions.

The concept of home range

Three components of a goshawk's home range (about 6,000 acres) were identified: nest area, post fledging-family area (PFA), and foraging area. The size of these home range components was determined from behavioral and radio-telemetry studies.

The nest area (approximately 30 acres) is usually located on a northerly aspect in a drainage or canyon, and is often near a stream. Nest areas contain one or more stands of large, old trees with a dense canopy cover. A goshawk pair occupies the nest area from early March until late September. It is the focus of all movements and behaviors associated with breeding.

The post fledging-family area (PFA) (about 420 acres) surrounds the nest area. It typically includes a variety of forest types and conditions, and represents an area of concentrated use by the family from the time the young leave the nest until they are no longer dependent on the adults for food (up to 2 months). It provides hiding cover and prey for developing hunting skills.

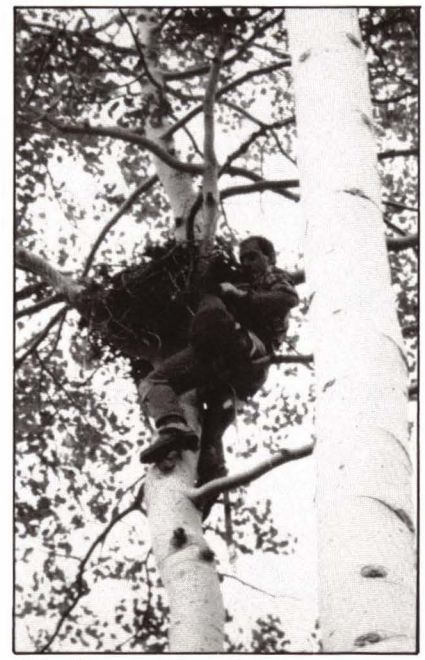
The foraging area surrounds the PFA. Hunting goshawks use available habitats opportunistically. This opportunism suggests that the choice of foraging habitat by goshawks may be as closely tied to prey availability as to habitat structure and composition.

Goshawk prey

A comparison of goshawk diets throughout North America shows that, while as many as 50 species are eaten, about 20 make up most of their diet. Fourteen of these species are considered important to the goshawks in the Southwest; they include squirrels, chipmunks, woodpeckers, jays, rabbits, and grouse. Specific habitat attributes used by these species include: snags, downed logs, woody debris, large trees, herbaceous and shrubby understories, and a mixture of various forest age-classes. Studies show that prey populations within goshawk foraging areas will be abundant when: 1) the specific habitat attributes are provided, 2) forests contain large trees and have relatively open understories, 3) forest openings are small to medium in size, 4) patches of dense, mid-aged forests are scattered throughout, and 5) the majority of acres are in the mid-aged, mature, and old-age forest classes.

Present forest conditions

Southwestern forests have been altered from pre-European settlement conditions by fire suppression, timber harvesting, livestock grazing, mining, and recreational uses. Prior to fire suppression in the western U.S., ponderosa pine forests were burned by low-intensity surface fires at 2- to 15-year intervals. Fires burned at lesser frequencies in mixed-species forests. These fires maintained forests that were relatively open and dominated by mature trees.



Scientists must often climb trees to access goshawk nests during the trapping process.

Habitat changes resulting from fire suppression are: 1) invasion of open, mostly single-storied stands by dense regeneration, 2) loss of openings by invasion of trees, and 3) changes in the abundance and composition of species in both the understory and overstory. Accumulated fuels and dense forest conditions resulting from fire suppression have also increased the potential loss of goshawk habitat through catastrophic wildfire and epidemic infestations of insects and diseases. Livestock and wildlife browsing and grazing, in addition to timber harvesting and related activities, have accentuated the loss of habitat of goshawks and their prey.

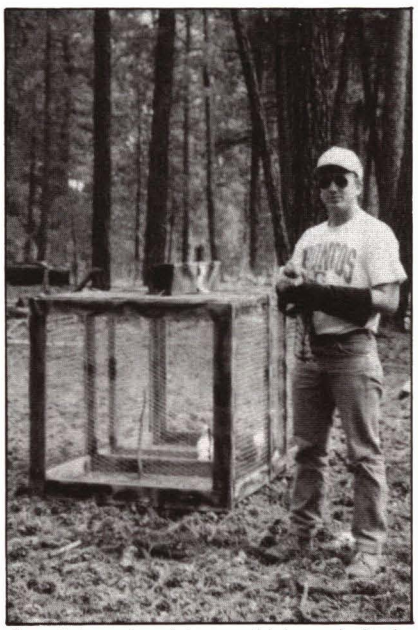
Management recommendations

The management recommendations note that the present conditions in southwestern ponderosa pine and mixed-conifer forests reflect the extent of human interference with natural processes. "Some active management, mainly thinning and prescribed fire, is necessary to produce and maintain the desired conditions for sustaining goshawks and their prey."

"Three suitable nest areas should be maintained per home range," says Reynolds. "In addition, three replacement areas should be developed and maintained per home range. Nest areas are typified by one or more stands of mature or old trees and dense forest canopies," he says.

The PFA contains a variety of forest conditions and prey habitat attributes; small openings, snags, downed logs, and woody debris. To sustain the desired canopy cover, size of trees, and the specified proportions of different forest ages within the PFA, small patches of forests should be regenerated every 20 to 30 years.

Small openings (less than 2 acres) in the forest are desired habitat for some prey species and are required for forest regeneration. If openings are greater than 0.5 acre in ponderosa pine and mixed-species forests, or 0.3 acre in spruce-fir forests, up to 6 large mature and/or old "reserve" trees should be left in groups in regenerated openings.



Swedish goshawk traps which are baited with protected, live pigeons are used to attract non-nesting birds.

Reynolds points out that management activities in the PFA should be limited to the period from October through February. Prescribed burning is the preferred method for management of woody debris. Thinning from below (removing understory trees) is suggested for maintaining desired forest structures, and a variable spacing of trees is best for developing groups of trees with interlocking crowns. Road densities should be minimized, and permanent skid trails should be used in lieu of permanent roads. Forage utilization should be 20 percent or less to maintain grass, forb, and shrub layers which are important food and cover for most of the prey of goshawks.

"Management recommendations for the foraging areas are similar to the PFA," says Reynolds. "Because the foraging area need not provide hiding cover for fledgling goshawks, a more open canopy is preferred—40 percent in the mid-aged forests and 50 to 60 percent in the mature and old forests—depending on the forest type. Medium openings (less than 4 acres) for understory development and tree regeneration are desired in ponderosa pine and mixed-species forests; smaller openings are desired in spruce-fir forests.

"A large-scale geographic and multi-resource approach is necessary when managing forests for the goshawk," says Reynolds. "It's important to note that the approach used in these recommendations provides for many wildlife species, plus timber and forage. Timber harvesting is not excluded by these recommendations—in fact, some harvesting is encouraged, albeit in a manner that mimics the effects of natural forest disturbances—to aid in the development and maintenance of the desired forest conditions for goshawks and their prey," he says. Reynolds stresses that these recommendations are not a "quick fix". "In many situations, it will take decades to reach desired conditions," he notes, "but the recommendations are basically good for maintaining biodiversity and healthy forests that are relatively safe from catastrophic fires and pests."

The effects of northern goshawk (and Mexican spotted owl) guidelines will be featured in an environmental analysis by the Southwestern Region. Results of the analysis will be used to amend long-term, multiple-use forest management plans for the 11 national forests in Arizona and New Mexico. The analysis will be documented in one or more environmental impact statements and the public will be invited to comment on the draft documents.

Nestling goshawk being prepared for banding and measuring which includes weighing the bird and measuring its beak, wings, and claws.

The analysis and final document should be completed in about 2 years. Formal public notice was published in the June 24, 1992 Federal Register.

Meanwhile, the Southwestern Region has adopted interim guidelines to provide for the needs of the northern goshawk. These guidelines were effective June 8, 1992, and extend specific management requirements from the current 600 acres to 6,000 acres around the nearly 250 known goshawk nesting areas in Arizona and New Mexico. The guidelines will also be used when additional goshawk nesting areas are identified in the Region. The guidelines were published in the June 19, 1992 Federal Register.

Besides banding and measuring goshawks, researchers subject droplets of the bird's blood to Allozyme and DNA analyses to determine genetic variation among and within goshawk populations.

If you would like further information on this research and the recommendations, the Rocky Mountain Station has just issued a new report titled *Management Recommendations for the Northern Goshawk in the Southwestern United States*, General Technical Report 217. Copies are available upon request. Rich Reynolds can be contacted by writing him at the Rocky Mountain Station, 240 West Prospect Rd., Fort Collins, Colorado 80526.

Root disease: the unseen killer

by Keith Jenkins
Pacific Southwest Station

There is an unseen killer lurking in the forest - and it's called annosum root disease. This root disease is caused by the fungus *Heterobasidion annosum*, a fungus belonging to the group that forms brackets or conks. These conks are the reproductive structures of the fungus, producing spores that are wind disseminated. *H. annosum* has existed in conifer forests long before man started to manage them; however, as man increased utilization of the forest the fungus has become more widespread and damaging.

Cutaway portion of a pine stump showing basidiocarp (conk) of H. annosum and associated wood decay.

This fungus causes serious problems in coniferous forests throughout North America, Europe and Scandinavia. One of the first finds of this disease in the West was recorded in the early 1900's in Monterey, California, on Monterey Pines. The fungus is widespread in California affecting pine, true firs, and other conifer species in most national forests in the State. Because of the varied and often use of California forests for timber production and recreational activities, and the diversity in climatic conditions and tree species associated in the State, the biology of this fungus and the disease it causes is quite complex.

The main effect

The life cycle of the fungus begins with airborne basidiospores landing on freshly cut stump surfaces. It is suspected that some tree species such as true fir may become infected through basal wounds in addition to freshly cut stump surfaces. The spores then germinate, grow through the stump wood and enter the stump root system decaying the woody portions of the roots . Previously healthy trees become infected when their roots come into contact with stump roots containing the fungus. In this manner, the fungus spreads from tree to tree, often creating openings in the forest ranging in size from a single tree to openings of several acres.

Survival of the fungus for up to 50 years in old, infected stumps under the climatic conditions found in the western United States is not uncommon. The fungus in these old stumps can then continue to kill regenerated trees once they grow large enough for their root systems to make contact with the fungus.

In addition to mortality, this disease has other effects as well. In some tree species, such as true fir, infection by the fungus may result in slow decay of root systems lasting decades before the tree succumbs. These trees are often wind thrown because of the decay of their anchoring roots. Also, this type of chronic infection may result in considerable growth loss long before symptoms appear.

Another important consequence of infection by *H. annosum* is that it renders infected trees susceptible to bark beetle attack. During periods of normal precipitation, trees infected with *H. annosum*, because they are under stress, maintain endemic levels of certain tree killing bark beetles. When protracted drought occurs these endemic beetle populations build up rapidly and cause extensive, catastrophic mortality in affected stands. Thus, if we can control the extent of root disease in forest stands, we may be able to lessen the effects of drought induced insect outbreaks.

Jeffery pine dying from H. annosum root disease around an old, infected pine stump.

Recognition in the field

When trying to detect the presence of the disease in the field it is best to look at recently killed trees or trees with advanced symptoms. Some of the symptoms and signs associated with this disease are visible signs of crown decline, a gradual reduction in growth, a loss or shortening of foliage, yellow needles, dead branches, and trees that generally exhibit poor health and are not performing as well as other trees in the stand. At the other end of the tree, evidence of the disease can be found in the roots. Resin soaked roots and wood decay is often the signal of fungal infection. In pine stands, dead and dying trees in a group around old stumps are grounds for suspicion of annosum root disease. These signs are often not as evident in true fir stands, although experienced observers may detect reduced new branch growth in infected trees.

Impact on the forest

All things considered, tree mortality associated with annosum root disease in commercial forests usually means a loss in timber resource value. There are also intangible values at risk such as aesthetics and safety in recreational areas. As our population increases the demand for multiple uses of these forests will increase. Therefore, losses directly (tree mortality and growth loss) and indirectly (catastrophic insect outbreaks) linked to this disease will take on added importance as time moves forward.

Ongoing research

For more than eight years, Dr. William J. Otrosina, a research plant pathologist for the USDA Forest Service's Pacific Southwest Research Station, headquartered in Albany, California, has focused his research on annosum root disease. He notes that annosum root disease is a constant factor in the forests, and a fundamental problem when it comes to forest health and productivity. "They (root diseases) are a highly underrated problem because we often don't see the dramatic effect on forests that we usually observe with insect attacks," says Otrosina.

Greenhouse inoculation experiment designed to study pathogenicity and host specificity of biological species of H. annosum.

The goals of his research are to understand the basic biology, ecology, and genetics of the fungus as they relate to various forest tree species. Results of this research will enable the development of methodologies to detect, quantify, and predict losses to this root disease.

Recent contributions to our knowledge of this disease by Otrosina's research unit centers around the existence of two biological species of *H. annosum* in the western United States. These biological species were first discovered in Finland in 1978. Our research, in cooperation with the University of California, Berkeley, has shown that these two biological species of *H. annosum* are pathologically different fungi, each infecting specific tree species. These findings were determined through a coordinated study of genetic characteristics of the fungus, field sampling, and greenhouse inoculation experiments. One biological species, known as the P group, was shown to attack primarily pines, junipers, and incense cedar while the other biological species, known as the S group, infected true fir and sequoia. Methodology was also developed to rapidly distinguish the two biological species. This represents a significant breakthrough in that the land manager, by knowing which biological species of the fungus predominates on an affected forest site, has the option of reducing losses to this disease by silviculturally encouraging species that are not susceptible to the biological species of *H. annosum* present.

Otrosina believes that if we can get a handle on the annosum root disease problem, we may be able to lower endemic insect populations at least to the point where they may not increase as rapidly during periods of drought and other agents of stress, such as air pollution. Otrosina also feels that continued research and technology transfer will enable land managers to make more informed decisions when it comes to dealing with annosum root disease.

For more information on annosum root disease research, contact the Pacific Southwest Research Station, P.O. Box 245, Berkeley, CA 94701, (510) 559-6470.

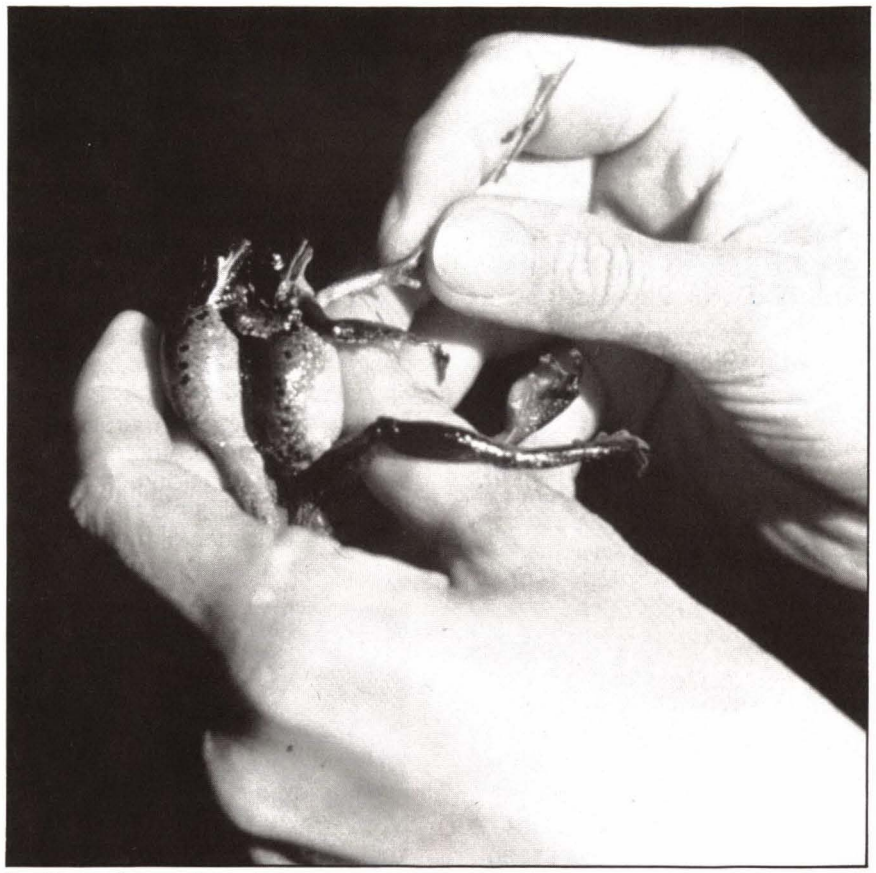
Frogs: are they disappearing?

by Sherri Richardson
Pacific Northwest Station

Frogs. They are a part of folklore, children's literature, French cuisine. They are primary prey for snakes and mammals. And people just enjoy seeing and hearing them during recreational outings. But are frogs becoming a thing of the past whose existence will be remembered only through folktales and lore?

Scientists are concerned that frogs are disappearing fast, with many unexplained losses. Amphibians evolved more than 350 million years ago and are among the oldest creatures on Earth, embedded within the web of life in both aquatic and land environments. Their decline is alarming to many biologists.

Deanna Olson, a fisheries biologist in the Pacific Northwest Research Station in Corvallis, Oregon, is among the concerned. "Losses have been observed locally and worldwide. Biologists are especially concerned about the causes of unexplained amphibian declines. Amphibians may be more sensitive to environmental changes than other species, making them good indicators of environmental health," says Olson. "The consequences of amphibian declines is another unknown, although we think amphibian loss may have some impact on nature's food chain."



Pacific treefrog mating pair.

Frogs have permeable eggs and skin which may make them uniquely sensitive to changes in the environment. Olson and other herpetologists are concerned that frog losses may signal water, soil, or air toxicity, or that the losses may reflect the detrimental effects of increased levels of ultraviolet radiation hitting the Earth's surface due to the loss of the ozone layer.

Frogs also are a vital link in the food chain. They eat insects, aquatic plants, and other organisms. In turn, fish, mammals, reptiles, and birds eat them.

Birds and mammals have always been more closely monitored than amphibians. Their neglected status coupled with their potential importance are major reasons why biologists have focused their research on the decline of amphibians across the globe.

Frog declines in the Northwest

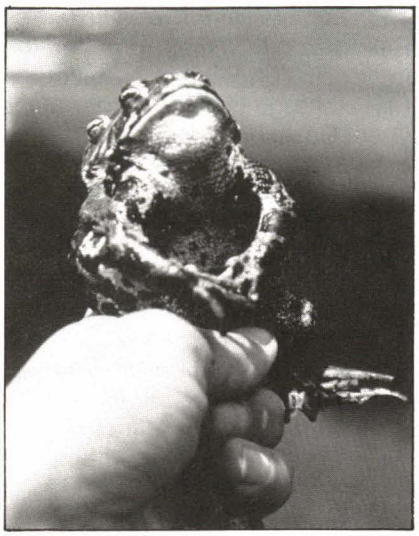
The decline of amphibians in the Northwest is of particular concern. The Oregon Department of Fish and Wildlife included an alarmingly high proportion of native amphibian species on their 1992 Sensitive Species List, a "watchlist of fish and wildlife species that are potentially eligible for listing as threatened or endangered." The list includes more than 70 percent of the native frogs in western Oregon and about half of the salamanders in the State. No other vertebrate group approaches these incredibly high proportions of species at apparent risk.

Olson began studying amphibians in the central Oregon Cascade Range in 1982. Since the mid-1980s, mass mortality and unexplained disappearances have been seen among two species, the western toad and the Cascades frog. "There doesn't seem to be any one reason for losses of Cascade Range amphibians, but several contributing factors may be involved. Among known causes of losses are drought conditions, predation, and disease, while other impacts yet to be ruled out are very extensive", says Olson. "For example, drought conditions in 1992 were particularly severe at high-elevation breeding sites. Some ponds dried up leaving millions of eggs and tadpoles to die. Many attacks by predators at breeding sites also has been a factor. Ravens, in particular, have been keying-in on the communally breeding western toads. Ravens are very clever, very intelligent, so in order to avoid the toxic skin and eggs of adult toads, they either skin or disembowel the toads."

Neighboring states and regions also are experiencing dramatic amphibian losses. The Cascades frog, for example, has been severely affected in northern California, while the western toad has disappeared from several historical localities in the Rocky Mountains. Predation, drought, and disease are contributing factors under consideration by biologists in California to explain widespread losses of high-elevation toads and frogs.

Olson's current research addresses the habitat areas required by high-elevation amphibian groups. For example, do frogs at a pond represent an isolated population that can persist over long periods of time, or is there a network of migration among ponds linking sites within a basin or across a landscape? "If frogs cannot persist in isolation, but rely on migration from elsewhere, basin or landscape scale distribution patterns and land management policies need to be considered. This brings us to the concept of habitat fragmentation and its possible role in amphibian losses. High-elevation amphibian habitat is naturally fragmented by

Western toad carcass left by raven. Toad skin is toxic so ravens peel the skin and eat the internal organs.



Western toad breeding pair.

topography, and further fragmentation of suitable amphibian habitat could occur with a host of land use practices," says Olson.

International studies of frog declines

Scientists from all over the world came together at the first World Congress of Herpetology held in 1989 in Canterbury, England, to discuss their concerns about the disappearances of frog populations. Sixteen countries on five continents reported declines in frogs, toads, and other amphibians.

Then, in 1990, the Species Survival Commission of the International Union for the Conservation of Nature and Natural Resources (IUCN) established the Declining Amphibian Population Task Force (DAPTF) to assess the situation globally. The DAPTF's international coordinator is based in Corvallis in the Environmental Protection Agency's research laboratory and has been organizing a global monitoring program for:

- determining the status of amphibian populations

- identifying species that have documented significant population declines or are considered "sensitive", threatened, or endangered

- identifying critical habitats of recognized fragility or limited area inhabited by amphibian populations

- studying potential causative factors of losses

- making appropriate policy recommendations based upon these findings

The laboratory has a full-time information systems manager who is currently compiling a bibliography of reports, theses, dissertations, and other literature pertaining to amphibian populations. The DAPTF also publishes a newsletter, "Frog Log," and is developing a database that will be available to scientists worldwide.

Olson, as cochair of the Pacific Northwest Working Group of the DAPTF, is involved with the assessment of the regional amphibian fauna. "Our working group is attempting to focus attention on the status of Pacific Northwest amphibians," says Olson. "Amphibian distributions need to be reviewed throughout our region, and to do that we need to coordinate monitoring efforts by researchers, state and Federal agencies, several nature societies, as well as individuals interested in the animals and issues."

For more information contact Deanna Olson at the Pacific Northwest Research Station, Corvallis Forestry Sciences Laboratory, 3200 S.W. Jefferson Way, Corvallis, OR 97331, (503) 750-7373.

Partnership for big game

by Dave Tippets
Intermountain Station

Big game find good cover, but little food in the pinyon-juniper forests that cover much of the mid-elevation zones of the interior west where most winter range is located.

After hauling truckloads of deer carcasses off golf courses and from the foothill edges of Wasatch Front communities, Utah wildlife managers knew they had to do more than wait for nature to balance the population through starvation.

"There was a common problem of mutual interest," Shrub Improvement Project Leader Durant McArthur says, describing how the oldest research partnership between Forest Service Research and a State wildlife agency was formed.

During 1992 the Intermountain Research Station and the Utah Division of Wildlife Resources will celebrate the 38th year of their partnership that was stimulated by the deer population explosion and crash that followed World War II. Deer herds started to increase during the war years when hunting pressure was light and had so expanded by the end of the war that hunters couldn't harvest the surplus.

The Utah Division of Wildlife Resources (DWR) approached the Intermountain Research Station (INT) through Perry Plummer at the Great Basin Field Station and asked for assistance in finding ways to increase the carrying capacity of Utah's winter ranges.

From that request for scientific assistance, a partnership for improving big game winter range evolved that thrives today. The partnership has borne fruit beyond just feeding more deer.

Elk herds expanded dramatically

Utah's elk herds have expanded dramatically in areas where the research results have been applied to range improvement. Private land depredation conflicts have been reduced by reducing winter deer and elk movements onto alfalfa fields and haystacks. Deer mortality on highways has been reduced where deer used to cross at night to invade farms and ranches.

Funded by Pittman-Robertson Act habitat-improvement money, the State hired research wildlife biologists to work with Forest Service range scientists, ecologists, botanists, geneticists, plant physiologists, pathologists, and economists. The work was first headquartered at the Great Basin Field Station in Ephraim, UT, but now Forest Service scientists that support the partnership work at the Shrub Sciences Laboratory in

Provo. The State maintains three researchers and support staff at the Field Station in Ephraim.

Research Wildlife Biologist Richard Stevens, headquartered at Ephraim, supervises the State's team. In 1990, Stevens received a Forest Service National Research Partnership Award from the Chief for the State's contribution to the partnership. Biologists Kent Jorgensen, Scott Walker, and Clerk-Typist Christine Wade also work at Ephraim. Both the research and the number of researchers have expanded since the partnership was born 38 years ago. In 1959, Plummer summarized the objectives of the partnership aimed at learning:

* plant species adapted to winter range improvement

*suitable planting sites

* conditions favorable to germination

* effective methods of planting and propagation

* ways to protect seeds and young plants from animals

* practical procedures for restoring game ranges

State Biologist Jim Davis, located at the Shrub Sciences Laboratory in Provo, has recently changed his emphasis from game-range improvement to monitoring the long-term trend for game ranges throughout Utah. Station scientists will collaborate on the monitoring work by providing support to Davis, and learning from his long-term trend data how specific shrubs are performing.

In another expansion of the partnership, Station Plant Physiologist Bruce Welch has worked with State Biologist Jordan Pederson on forage nutritive quality studies for wildlife. Welch is also collaborating with the State and the Uinta National Forest on sage grouse habitat research in Utah's Strawberry Valley.

Station Botanist Steve Monsen began his research career on the State side of the partnership. After transferring to INT and working in the Idaho Batholith, Monsen is now at the Shrub Sciences Laboratory and active on the Station side of the partnership.

In addition to scientific collaboration, the Station provides the State scientists with statistical support and editorial support for publishing research results and management recommendations.

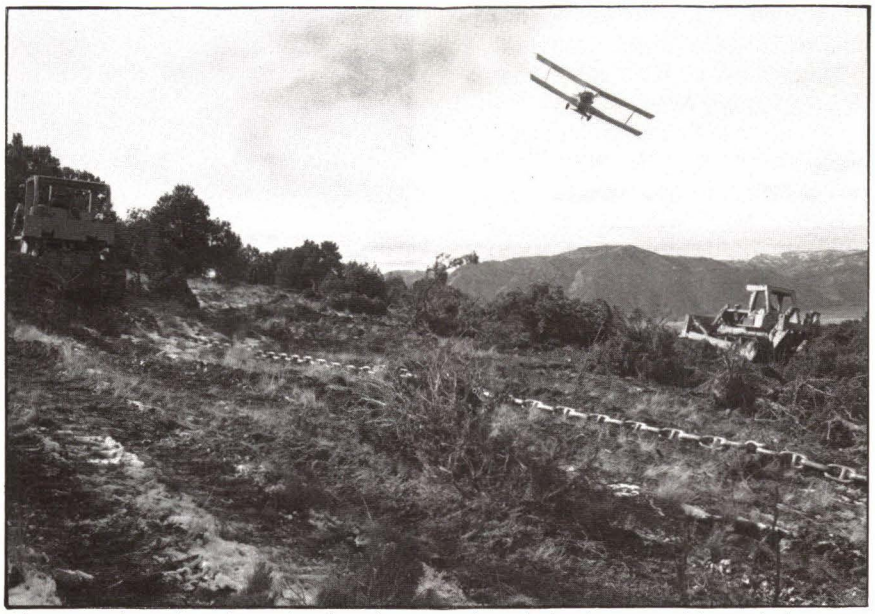
Research results have also contributed to the improvement of range for livestock and disturbed-land rehabilitation. Much of our knowledge about equipment and methods for reseeding rangeland for livestock came from this research partnership.

Studying and developing plant materials for rehabilitating damaged habitat began as one of the first partnership research priorities and continues as a priority today. Scientists have discovered highly palatable sagebrush and rabbitbrush, plants that range managers formerly tried to eliminate to favor other species like antelope bitterbrush. These genetic selections will actually perform better than bitterbrush as a browse producer. They have also produced varieties of saltbush and cliffrose.

When the partnership launched its winter range improvement effort there were only 10 kinds of seed available for plants that could be grown on winter range. Now, as a result of the partnership's effort, managers have the seeds of 60 species available to choose from for winter range improvement.

The partners have worked with the Soil Conservation Service to produce 14 joint releases of new plant materials, and some like Ephraim crested wheat and Paiute orchard grass have become some of the most popular species for rangeland planting. For their successes, the Soil Conservation Service gave both Monsen and Stevens the National Plant Material Award.

Although the new shrubs made available by the partnership aren't as popular as the grasses or legumes for general range improvement, some may have even greater ecological significance. They have selected genetic varieties of big sagebrush that will sprout after fire and can survive on cheatgrass-dominated ranges where frequent fire previously destroyed valuable browse, converting the sites to annual grass monocultures.



After uprooting strips of trees by dragging a large chain between two crawler tractors (chaining) the strip is aerially seeded and then chained a second time to help cover the seed.

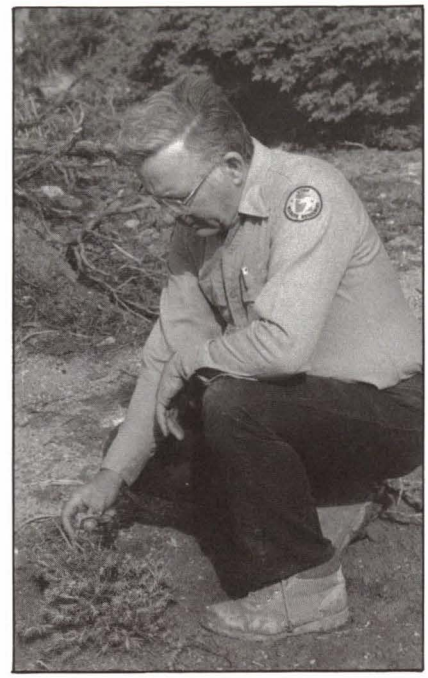
Unopposed P-J chaining

Partnership researchers are studying manipulating pinyon-juniper forest to increase forage and browse production. Because pinyon-juniper forests cover a third of Utah at mid-elevations, this zone has tremendous potential for winter range. Studies show that by removing juniper the forage production will increase 50-300 percent, mostly as a result of making more water available to forage species for seedling germination and growth. Forage values can improve even more dramatically by seeding after tree removal.

Chaining, the most common mechanical tree removal method, has often been controversial on public lands and often opposed. But a project that follows the current guidelines recommended by Stevens to improve wildlife habitat has never been opposed by environmental groups.

Size and location of openings, as well as proper selection of seeded species, are fundamental to the guidelines that make chaining acceptable to environmentalists. The State recommends that wildlife openings be kept small and shaped to fit the land. Seed mixes should meet the needs of a variety of wildlife with a mix of grass, forbs, and shrubs, rather than the introduced grass monocultures that were once popular for rehabilitating livestock ranges.

Researchers now study how pinyon-juniper manipulation can return the land to a kind of biodiversity similar to what existed prior to frontier expansion and the ensuing overgrazing and fire control that encouraged pinyon-juniper forest domination of once more productive mosaics with grasslands and shrublands. In the earliest days of the partnership scientists looked for ways to maximize forage and browse with artificially seeded species. Now the approach has changed to looking for rehabilitation methods that will return the habitat to a natural diverse mix of native species by stimulating positive successional trends.



Research Wildlife Biologist Richard Stevens examines a small pinyon that like many others survived the chaining and with more water and sunlight will grow rapidly to provide structural habitat diversity in the chained strip.

Being able to predict successional pathways and what vegetation will be like at different stages of succession is as important to winter range improvement as it is in silviculture.

Research by Robin Tausch of INT's Reno, NV, Pinyon-Juniper Ecology unit shows that many sites don't have the ability to return to presettlement conditions. Human activities have created thresholds in the successional pathways that can prevent an area from reaching its earlier productive potential.

In these cases overgrazing and fire suppression may have created dense forests, but the more productive range will not restore itself naturally after grazing and fire are properly managed.

One of the most common changes in succession and site potential occurs after heavy grazing and fire suppression promotes succession to dense forest with little understory vegetation. Unlike many other kinds of mature forests in areas with heavier rainfall, arid pinyon-juniper forests with little understory vegetation don't protect the soil from erosion during cloudbursts. And once topsoil is lost the successional pathway and site potential is altered.

Dense and unnaturally dominant pinyon-juniper forests also short circuit natural succession through amplifying the allelopathy of pinyon and juniper. Under natural conditions with natural-fire frequency and healthy stands of understory vegetation, the allelopathic chemicals don't seem to hurt established forage plants, but once that vegetation is lost allelopathic effects, compounded by competition for soil moisture, can prevent the establishment of new browse, forbs, and grass.

Investigating ways to effectively plant and propagate browse was one of the first objectives of the Intermountain Research Station's partnership with the Utah Division of Wildlife Resources. In this example of research application, some large heavy seeds, such as those of bitterbrush that can't effectively be seeded with aircraft, are planted with the "seed dribbler" attached to the tractor dragging the chain. The seeds dribble onto the track and then fall into the shallow compressed furrows made by the tractor's cleats.

To make wise decisions about manipulating vegetation, land managers should consider site potential, and then think through the guidelines developed by the Utah partnership. The partnership's recommendations and guidelines were first published by the then Utah Division of Fish and Game in *Restoring Big Game Range in Utah*, Publication No. 68-3. Although still valuable when you can find it, the book is out of date and out of print.

In that book appeared what have become known as Plummer's Ten Commandments for Range Improvement:

1. Change in plant cover must be determined, by rational criteria, to be necessary and desirable.

2. Terrain and soil type must be suitable to making the change selected.

3. Precipitation must be adequate to assure establishment and survival of planted species.

4. Competition must be low enough to assure establishment and survival of planted species.

5. Only species and strains of plants adapted to the area should be planted.

6. Mixtures of plant types rather than a single species should be planted.

7. Sufficient seed of acceptable purity should be planted to ensure getting a stand.

8. Seed must be covered sufficiently.

9. Planting should be done in a season that gives promise of optimum conditions for establishment.

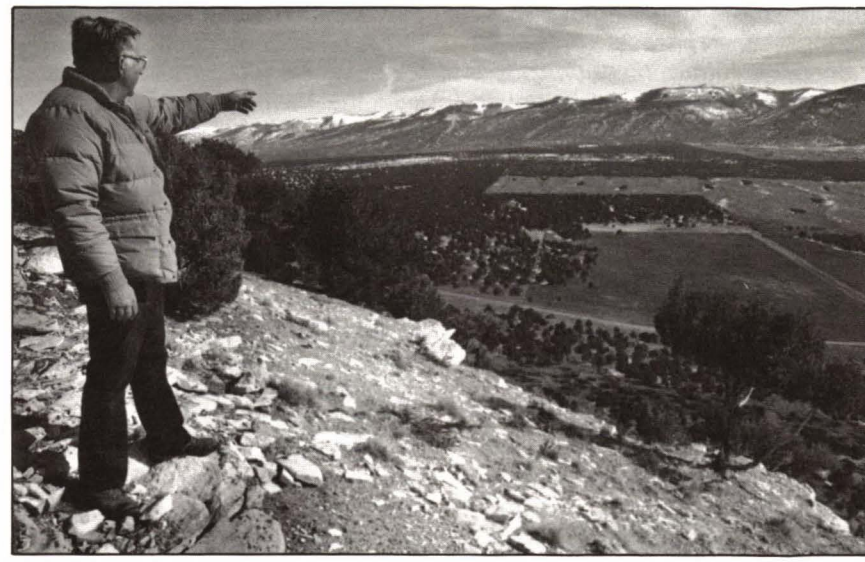
10. The planted area must not be overgrazed.

Monsen and Stevens are compiling a new handbook, *Rehabilitation of Western Ranges and Wildlands*. Until it appears, *Management of Pinyon-Juniper Woodlands*, General Technical Report INT-249, is a good summary of improvement options and considerations for the winter range within the pinyon-juniper zone.

The Utah research partnership is searching for alternatives that have better wildlife habitat values than are usually found in dense pinyon-juniper forests with little understory vegetation, cheatgrass dominated ranges, and other degraded ranges that are below their potential.

Pathway to biodiversity

The desire to induce successional pathways to more natural and diverse communities of native species has stimulated more new research into autecology and synecology. For example, researchers observed that there was little or no natural recruitment of bitterbrush into communities of some seeded grass species. They are now searching for understanding of the requirements for natural bitterbrush recruitment, and investigating what seeded communities will best encourage natural recruitment of palatable native species that can thrive on the site.



Utah Division of Wildlife Resources Research Wildlife Biologist Richard Stevens points to a large square pinyon-juniper chaining on private land done to increase feed for livestock. It illustrates the kind of manipulation that has stirred public sentiment against chaining. Studies have shown that these kinds of treatments produce habitat with little value for wildlife. Openings are too large and the vegetation conversion is to almost pure grass. The patches of trees left in this type of treatment are too small and too isolated to provide adequate security for big game.

Chaining or other treatments followed by seeding can prepare the site for a natural colonization by desirable native species that would not have been able to establish themselves in the understory of a dense pinyon-juniper forest. The seeded species stabilize the soil and create the microsites needed for natives to colonize the treated area. Unlike earlier projects, the partnership researchers aren't searching for seeded grasses that will dominate the site for the long term.

"I spent the first half of my career killing sagebrush and planting crested wheat, and the last half growing sagebrush and convincing others not to plant crested wheat," Stevens quotes Plummer.

During a recent tour of some of the study sites, Stevens showed robust stands of bluebunch wheatgrass that had established themselves in the artificially seeded communities. Many of the seeded species were still present, scattered in the native bunchgrass community. Such areas are examples of successfully stimulating succession in the direction to achieve the desired future condition of a complex and diverse ecosystem.

Smooth brome, intermediate wheatgrass, and crested wheatgrass are valuable in seedings for domestic livestock, but research has shown that they are counter productive in seed mixes if managers want to manage for biodiversity and wildlife habitat. These species can dominate sites, producing less diverse and less stable communities. Once they dominate a site, succession bogs down at a stage of less than optimal value for wildlife.

Research has also shown that some introduced species do not compete with or inhibit desirable natives and should often be in seed mixes if the objective is to feed big game. For example, Paiute orchard grass, alfalfa, and small burnet all contribute significant community values without preventing the natural re-establishment of native plants.

Visible success

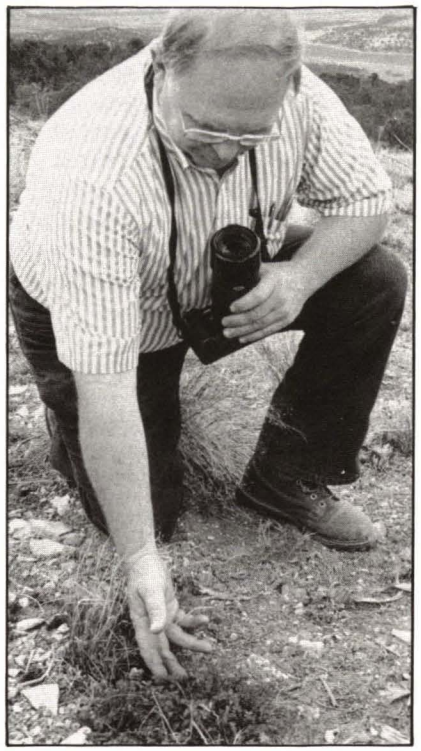
During a tour in December 1991, Stevens had no trouble showing the success of application of project recommendations. Hundreds of mule deer and elk were concentrated on the improved ranges eating the species of browse, evergreen forbs, and grasses seeded to improve the habitat.

Stevens also found it easy to show range improvement efforts not following the partnership's guidelines that have produced range almost worthless to wildlife. The most common problems are making openings too large and converting the range to monocultures of grass.

If ranchers or agencies in Utah will follow the guidelines developed for wildlife, DWR will furnish them with the best seed mix for their location. Most of the seed used is carefully selected genetic strains of native species, but some alfalfa and some introduced grasses are frequently recommended in seed mixes.

The Forest Service, the Bureau of Land Management, and private land owners increasingly cooperate with the State for range improvement that improves wildlife habitat.

"If you can't see it, it's not there," Stevens quotes his old boss Plummer, referring to research results. In the case of the success of this partnership, you can see it on the winter range, and you can see it in the growing elk herds wintering on improved range in the pinyon-juniper zone.



Intermountain Research Station Botanist Steve Monsen shows the introduced forb "small burnet" that adds a desirable evergreen forb to the community without inhibiting natives in a successional trend towards a more natural biodiversity.

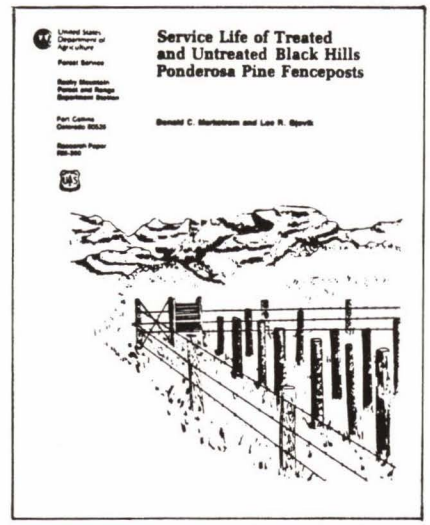
New from research

Treated fence posts prove effective

A recently completed 30-year study on treated and untreated Black Hills ponderosa pine fenceposts showed that with treatment, fenceposts last longer and therefore cost less to maintain. The study, which took place on three sites with varying climate conditions, tested twelve treatment combinations of chemicals, pressures, and retention levels against their untreated control counterparts.

Results showed that the probable life of untreated posts is approximately 11 to 13 years, where a treated post—depending on treatment choice—could last from 16 to 29 years. Consequently, untreated posts have a higher annual service cost of up to $1.18 per post compared to treated posts which can cost as low as $0.85 per post annually.

To learn which treatment combinations proved most successful, request Research Paper RM-300, *Service Life of Treated and Untreated Black Hills Ponderosa Pine Fenceposts*, from the Rocky Mountain Station.



Kochia wins survival test in salt desert

Scientists from the Shrub Sciences Laboratory tested 20 kinds of shrubs for potential use in desert rehabilitation and *Kochia prostrata* finished the trials as a winner.

Ecologist Rosemary Pendleton, Range Scientist Neil Frischknecht, and Chief Research Geneticist Durant McArthur from the Intermountain Station's Provo, UT, laboratory planted the accessions in an environment that subjected the plants to many factors that contribute to shrub mortality. Of the 20 kinds, nine demonstrated the ability to survive. *Kochia* excelled above the others because it alone showed not only the ability to survive but also the ability to reproduce.

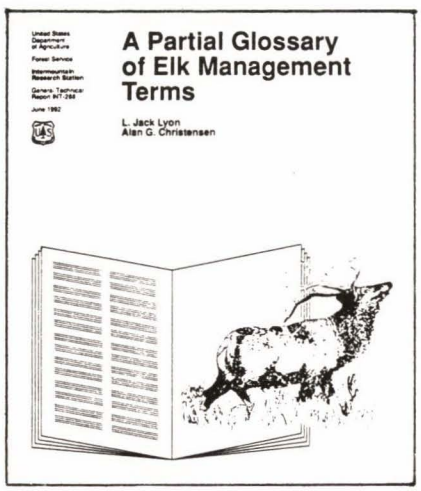
Some have expressed fear in introducing another exotic into rangelands where exotics have become significant management problems. This research shows that *Kochia* has some very unique characteristics—it has never been observed invading a healthy native plant community, but will invade cheatgrass-dominated range.

Because *Kochia* stays green after cheatgrass cures it shows great promise for a species to plant in "green strips" to act as a fire break, helping land managers break the cheatgrass-fire cycle.

Request *Long-term Survival of 20 Selected Plant Accessions in a Rush Valley, Utah, Planting*, Research Note INT-403, from the Intermountain Research Station.

Elk speak

Wildlife Research Biologist L. Jack Lyon and Northern Region Wildlife Program Leader and National Elk Initiative Coordinator Alan G. Christensen sought to prevent the confusion of multiple meanings for the same terms applied to elk management.



The confusion over terms has been significant enough that State, Federal, university, and private biologists met at the University of Montana's Lubrecht Experimental Forest during April 1990 to identify the the most commonly misused terms and develop consensus definitions. This brief report gives those consensus definitions.

As many National Forests developed elk habitat guidelines for forest plans, many common terms were misused and new terms were invented. As a result both managers and the public were often confused. Perhaps worse, elk management guidelines that were originally based on research data were sometimes extrapolated into circumstances that the research did not support.

"The future of elk management depends on clear communication among agency personnel and the public," the authors said. "We believe it is essential that that the terminology of elk habitat management be clarified and standardized."

Request *A Partial Glossary of Elk Management Terms*, General Technical Report INT-288, from the Intermountain Research Station.

What will the future hold for old growth forests?

A progressive workshop was recently held to discuss the current state of old-growth forests in the Rocky Mountains and Southwest. The goals of the workshop were to create a workable state-of-the-art definition of just exactly what old-growth is, and to brainstorm new management techniques to best preserve it.

Twenty-two professionals shared papers which challenged some current beliefs and management plans of old-growth forests in hopes of gaining a new perspective on what direction should be taken in the future. Some of the papers tackled such topics as the influence of fire, wildlife/forest interrelationships, and the human aspect in dealing with old growth.

For a copy of *Old-Growth Forests in the Southwest and Rocky Mountain Regions, Proceedings of a Workshop*, request General Technical Report RM-213 from the Rocky Mountain Station.

ATLAS: a timber projection model

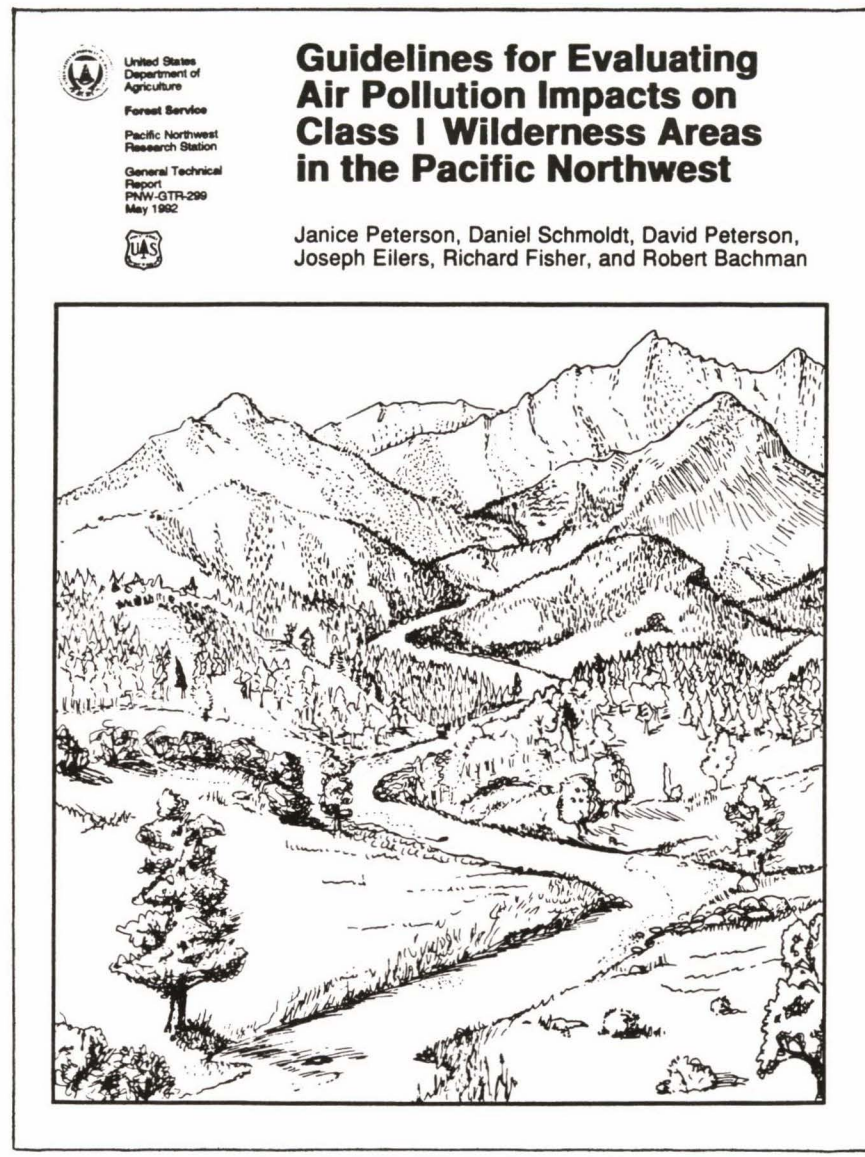
The total timberland assessment system is a time-based timber projection model. It was developed by the USDA Forest Service to address broad policy questions related to future timber supplies for the 1989 Renewable Resources Planning Act for timber assessment. An open framework design allows for customizing inputs to account for regional and subregional growth and yield characteristics, predictions of change in land use, assumptions of future timber management practices, and projections of future demand for stumpage.

Request *The Aggregate Timberland Assessment System—ATLAS: A Comprehensive Timber Projection Model*, General Technical Report PNW-281, from the Pacific Northwest Research Station.

Guidelines for evaluating air pollution impacts on class I wilderness areas in the Pacific Northwest

Forest Service air resource managers in the Pacific Northwest are responsible for protecting class I wilderness areas from air pollution. To do this, they need scientifically defensible information to determine critical concentrations of air pollution having the potential to impact class I wilderness values. This report documents the results of a workshop where current information on air pollution effects on aquatic and terrestrial resources and visibility was gathered from participating scientists and managers. Critical air pollution concentrations were determined for sulfur dioxide, nitrogen dioxide, and ozone. Critical values for sulfur and nitrogen deposition to forest ecosystems are listed.

Request *Guidelines for Evaluating Air Pollution Impacts on Class I Wilderness Areas in the Pacific Northwest*, General Technical Report PNW-299, from the Pacific Northwest Research Station.


United States Department of Agriculture
Forest Service
Pacific Northwest Research Station
General Technical Report PNW-GTR-299 May 1992
Guidelines for Evaluating Air Pollution Impacts on Class I Wilderness Areas in the Pacific Northwest
Janice Peterson, Daniel Schmoldt, David Peterson, Joseph Eilers, Richard Fisher, and Robert Bachman

Trends in wilderness campsite conditions

After measuring campsite impact trends in three widely different wildernesses, researchers David Cole and Troy Hall concluded that managers would be more effective at restoring campsite condition if they place their emphasis on reducing impacts on lightly used sites rather than heavily used sites. But at the same time they learned that factors leading to deterioration or improvement are so complex that it's dangerous to make broad generalizations.

Their research on campsite trend in the Eagle Cap Wilderness, Bob Marshall Wilderness, and Grand Canyon National Park monitored changes in condition for up to 11 years. They studied both backpacker and horse packer campsites.

Heavily impacted campsites tended to deteriorate slowly with additional use, usually in the form of a widening of the impacted area. Most often completely closing heavily impacted sites resulted in little improvement, and in some cases the site continued to deteriorate after being closed to camping.

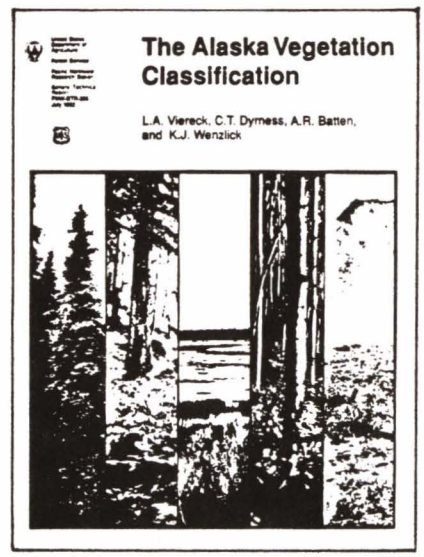
The most notable exception was in heavily impacted sites with deep productive soils and good rainfall. These productive sites demonstrated more ability to recover after heavy impacts.

Management implications from this research suggest that in areas where heavy concentrations of people can't be avoided managers should keep camping on the already heavily impacted sites, but manage them to maintain small perimeters. Keep party sizes small to help prevent the expansion of the perimeters of heavily impacted campsites. And perhaps most important, use education to prevent lightly impacted areas from becoming heavily impacted areas.

Request *Trends in Campsite Condition: Eagle Cap Wilderness, Bob Marshall Wilderness, and Grand Canyon National Park*, Research Paper INT-453, from the Intermountain Research Station.

The Alaska vegetation classification

This is the first comprehensive classification of Alaska's diverse vegetation, including everything from Sitka spruce forests of southeast Alaska to aquatic eelgrass communities of southwest Alaska to arctic tundra. This publication is a comprehensive, statewide system that has been under development since 1976. The classification is based, as much as possible, on the characteristics of the vegetation itself and is designed to categorize existing vegetation, not potential vegetation.



Request *The Alaska Vegetation Classification*, General Technical Report-286, from the Pacific Northwest Research Station.

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2) *Birds of a Great Basin Sagebrush Habitat in East-Central Nevada*, Research Paper INT-452.
3) *Long-term Survival of 20 Selected Plant Accessions in a Rush Valley, Utah Planting*, Research Note INT-403.
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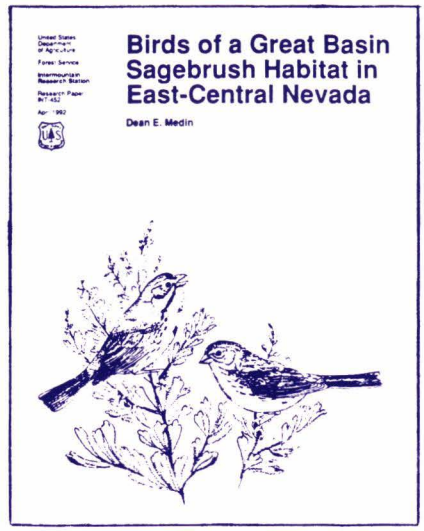
Birds of a Great Basin sagebrush habitat

Research Wildlife Biologist Dean Medin found breeding bird densities in his study sites in east-central Nevada to be significantly higher than compared to the same ecosystem type elsewhere where densities had been measured.

Medin's study site was lightly grazed by sheep. Areas compared to had been burned, plowed, chained, heavily grazed, and in two cases ungrazed. In comparing his statistics, it's interesting to note that the densities he measured in Nevada were about nine times greater than in the same habitat where breeding bird densities had been measured in east-central California where the type had been heavily grazed. But perhaps even more interesting to some is that the Nevada densities were 4.4 times greater than an ungrazed site in the same habitat in east-central California.

The publication doesn't explain why the variation exists between densities in all the different locations and kinds of management, but it does illustrate that density can vary significantly in the same ecosystem type.



In this study Medin measured densities for only the passerine species horned lark, sage thrasher, brewer's sparrow, black-throated sparrow, sage sparrow, and western meadowlark. Medin explains some species-specific habitat preferences for these species.

Request *Birds of a Great Basin Sagebrush Habitat in East-Central Nevada*, Research Paper INT-452, from the Intermountain Research Station.

Proceedings of the Intermountain Forest Nursery Association

Twenty-six articles on various aspects of nursery management in western North America are presented in this recently published proceedings of the Intermountain Forest Nursery Association's 1991 Symposium. Besides general nursery topics, articles fell under two special-focus categories: 1) agricultural pollution of surface water and groundwater in forest nurseries, and 2) propagating and outplanting native plants for riparian revegetation projects.

A sample of the papers include: "Socio-Political Factors and Nursery Management," "Vegetative Propagation of Poplar and Willow," and an "Update on National Tree Planting Programs."

For a copy of the proceedings, request General Technical Report RM-211 from the Rocky Mountain Station.

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